GF Steel-Tile

An Economical System of Floor Construction

The General Fireproofing Co
Youngstown, Ohio

GF STEEL-TILE

AN ECONOMICAL SYSTEM OF FLOOR CONSTRUCTION

A Statement of the Many Accepted Advantages of "T" Beam Floor Construction, with Particular Reference to the Use of Steel-Tile—a Collection of Tables for Designing and Building Steel-Tile Floors—a Complete Specification for the Work from Start to Finish

GF
YOUNGSTOWN, OHIO.

Trade Mark Reg. U. S. Pat. Off.

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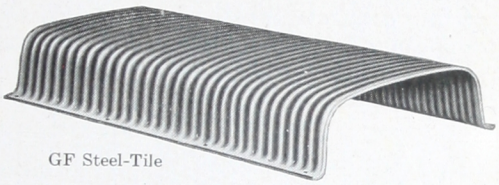
Steel-Tile Floors

An Economical System of Floor Construction

GF STEEL-TILE are in reality no more nor less than permanent steel forms for concrete floors designed on the T beam system —small beams or joists closely spaced, with a thin connecting slab of concrete.

This type of construction is recognized as particularly good on all long span work in such structures as schools, apartments, hotels, office buildings, lofts, warehouses and stores. Steel-Tile floors can be constructed at a substantial saving in cost and with absolute safety pre-determined. It does not matter whether the frame is of steel or of concrete—Steel-Tile are used to equal advantage in both types.

This method gives an exceptionally light floor and because the Steel-Tile, which are actually forms, carry all the concrete except the narrow joist, they save a great part of the usual cost of form work and centering.



GF Steel-Tile

Terra-Cotta tile and concrete floors, while built upon the same principle, that is, the T beam principle, are not to be compared with Steel-Tile floor construction. In the matter of dead load alone, the necessary Steel-Tile for a job will weigh only about 10% of the required Terra-Cotta tile, and the finished floor, of course, will show a proportionate saving with Steel-Tile. Add to that the reduced freight charges, lower handling expense on the job, and saving on the supporting members of the building, and the fact that Steel-Tile joists are spaced at least 24″ on center as compared with 16″ for Terra-Cotta tile, GF Steel-Tile floors are decidedly superior.

The flat slab reinforced concrete floor is also being displaced by Steel-Tile construction in many types of buildings. The chief saving here is in weight, for Steel-Tile forms eliminate a great part of the dead concrete with which such floors are burdened. The deep narrow joist in Steel-Tile floors have practically no useless material or dead load in them.

GF End-Tile

It is scarcely necessary to mention the superiority of Steel-Tile over non-fireproof construction. Fireproofness, with its resulting lower insurance rates and the total absence of up-keep expense, are enough to prove the case, even without the greater value of safety to life and property.

Ceilings, when applied beneath Steel-Tile floors, are uniformly smooth and never show up streaky as is often the case when other forms of tile are used.

The peculiar economies of Steel-Tile floors mentioned above and following in greater detail, have been combined with complete specifications and tables in order to give Architects, Contractors and Engineers a comprehensive knowledge of this most economical floor construction system, as briefly as possible.

GF Steel-Tile Floor Construction

GF Steel-Tile Floors are Light in Weight

Consider the fact that GF Steel-Tile occupy from 45% to 60% of the cubical contents of a floor. Where formerly this space was filled with lazy concrete or heavy tile, Steel-Tile transforms it into dead air space weighing nothing. Yet this is done without sacrificing anything in the strength of the floor.

Such a large reduction in actual weight permits lighter girders, lighter walls, in fact, lighter construction all the way through to the very footings of the structure.

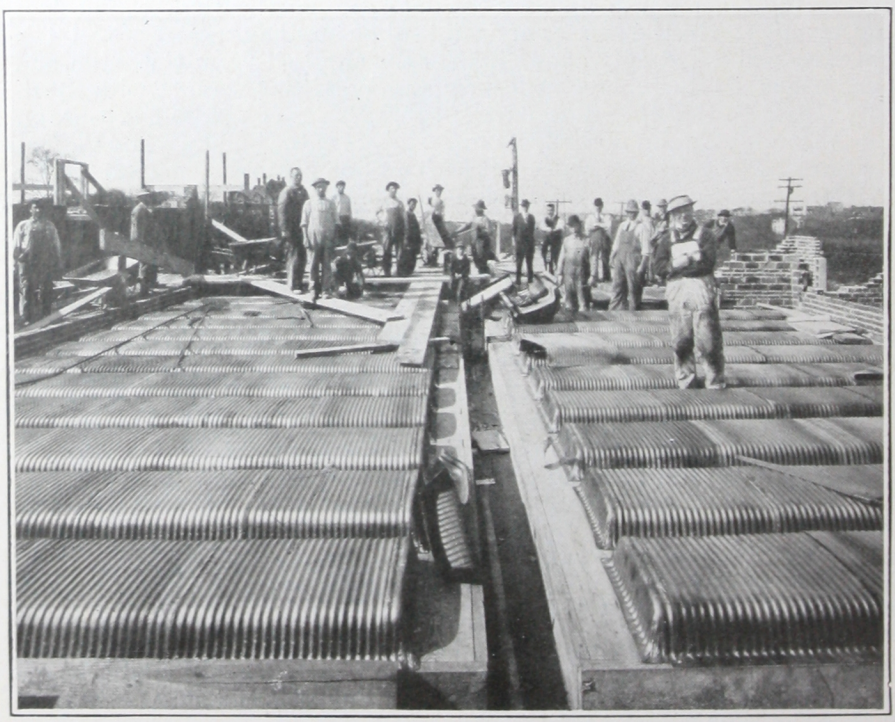
They Are Safe

Less weight does not in the least imply a sacrifice in safety. On the contrary every pound of concrete in Steel-Tile floors is of use and so built and graded from thin slabs to deep reinforced joists that its whole strength can be exerted in sustaining any live loads placed upon the floor.

From accurate tables on pages 12 to 20 inclusive, the necessary measurements are given for Steel-Tile floors which must support given loads over any of the spans most commonly encountered.

They Are Economical

Note again the proportion of Steel-Tile floor contents that is simply air space—45% to 60%. Here is a clear saving in material that means a



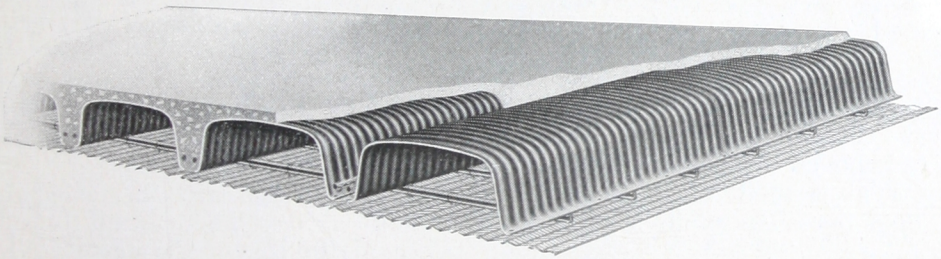
McSorley Duplex Apts., Pittsburgh, Pa.
Architects—Perry & Thomas, Chicago, Ill. J. McSorley, Pittsburgh, Pa., Owner and Builder

greatly reduced cost at the very outset. And that is not the only saving. Solid steel forms which lap tightly at both ends and are joined by a simple but effective centering on the sides, prevent any leakage and waste of concrete. The same forms made, as they are, from sheet steel cold pressed to shape, are transported cheaply and without danger of breaking. The laying of Steel-Tile is a simple matter quickly accomplished.

On pages 7 to 11 the form work or centering for Steel-Tile floors is shown. Notice that it is a simple skeleton frame with runners along under the line of the joists, with the intervening space left entirely open. Such form work requires much less lumber than the solid type used for floors of the solid concrete slab or tile block design, and less time is required to erect and tear them down.

They Are Quickly Laid

GF Steel-Tile can be laid more rapidly than any other form of fireproof floor construction. With the centering up, the Steel-Tile and reinforcing bars for thejoists are easily set in place. Sometimes spacers are used, but generally it is only necessary to nail the Steel-Tile lightly to the centering before pouring the concrete. End-Tile are set at the end of each row clos-



ing up the form and leaving the proper amount of space for concrete to take up any shearing tendency near the beam or girders. With two standard lengths of Steel-Tile—30″ and 35″—little time is lost in matching at the ends of odd length spans.

GF Steel-Tile are furnished immediately from stock in 6″, 8″, 10″ and 12″ heights and in 30″ and 35″ lengths. End-Tile to match are also carried for prompt shipment. These exclusive features of Steel-Tile floor construction and the more general advantages as outlined, warrant the consideration of Steel-Tile for almost every building operation. Interesting cost data and valuable advice will be furnished by The General Fireproofing Company if you will give them the necessary figures for your work.

Ceiling Construction With GF Steel-Tile

Flat ceilings and smooth surfaces are obtained with Steel-Tile floor construction.

Beams and girders are made of the same depth as the narrow joists and Herringbone Rigid Metal Lath is run continuously over the entire ceiling. Or, when walls occur, a smooth, clean angle or cove is easily constructed.

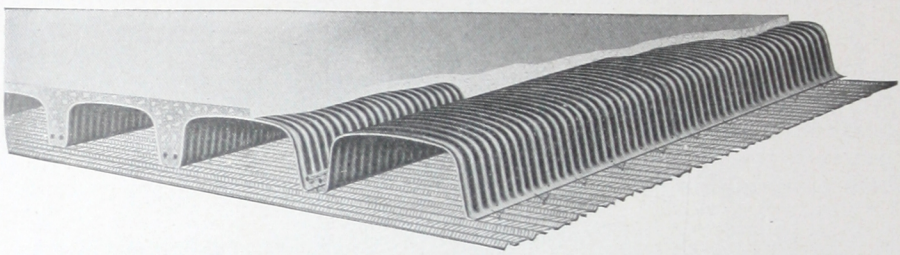
Two methods are in common use for ceiling construction.

The more practical method for all purposes is to finish the Steel-Tile floor before erecting any of the ceiling lath. Tie wires are run through the holes in the Steel-Tile and extended below the finished joist.

GF Steel-Tile Floor Construction

¾" GF Cold Rolled Channels are securely wired to the joists and the Herringbone erected in the usual manner beneath the channels.

When such a job is finished there is no possibility of streaking, for the ceiling plaster does not come in contact with the deep floor joists which dry out more slowly than the thinner ceiling and floor slabs. The surface is perfectly smooth and should a suspended ceiling be required, it can be easily put up by extending steel suspension rods down the required distance and erecting the channels and Herringbone as before. See page 10.



The second and simpler method is to place the Herringbone on top of the centering and lay the Steel-Tile directly on it. After the centering is removed the ceiling is plaster finished.

This method results in a very economical ceiling which can be depended upon to remain solidly in place and give good service. There is a direct saving of the cost of the channels plus a greatly reduced cost for erecting.

"AAA" Herringbone

The type of Herringbone recommended for ceiling work, where lath is fastened directly to the underside of joists formed by Steel-Tile, is AAA 24 gauge, which will easily span 20 inches. In channel-funed ceilings, AAA 27 gauge Herringbone should be used, channels to be placed on 16-inch centers.

AAA Herringbone is exceptionally well suited to the types of ceilings described because it is a metal lath possessing both the stiffness and bonding qualities so necessary for dependable ceiling work. Its heavy longitudinal ribs are set on an angle of 45°, giving rigidity; the intermediate strands are wide and flattened out just enough to permit the plaster to curl completely around the strands and form a perfect key.

Specify "Herringbone" Rigid Metal Lath for use with your Steel-Tile floors. The resulting job, top, bottom and all the way through, will be a source of complete satisfaction. Other uses for Herringbone are described at length in a new book which is furnished on request.

General Specifications for Reinforced Concrete

Additional Copies Furnished on Request

The floors and roofs shall consist of the GF Steel-Tile system of reinforced concrete construction, as shown on the accompanying plans, and all materials and workmanship shall be in strict accordance with these plans and specifications.

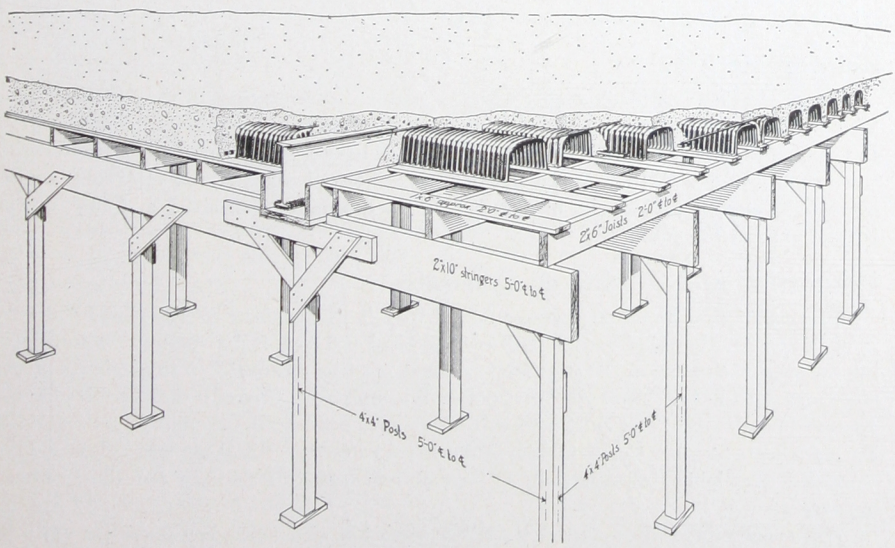
The Contractor shall, at all times during the progress of the work, provide a competent foreman who is thoroughly experienced in reinforced concrete construction, whose duty it will be to see that these plans and specifications are carried out. The Architect reserves the right, at any time, to discharge any incompetent or careless employee and such employee shall not be reinstated upon the work without special permission in writing from the Architect. The Architect, or his authorized representative, shall at all times have complete access to the work and the Contractor shall place at his disposal every facility for the inspection of material and workmanship.

Materials and Workmanship

The object of these specifications is to provide a first class structure and all work shall be done in a thorough and businesslike manner. All materials shall be in strict accordance with these specifications and any materials rejected by the Architect must be immediately removed from the vicinity of the work.

Cement

The cement used in this work shall be Portland Cement and must conform to the standard specifications of the American Society for Testing Materials. All cement shall be tested as directed by the Architect before being brought to the vicinity of the work, and the Contractor must provide ample time for performing these tests so that no delay in the work will be occasioned.



GF Steel-Tile Floor Construction, showing Typical Form Work

GF Steel-Tile Floor Construction

Sand

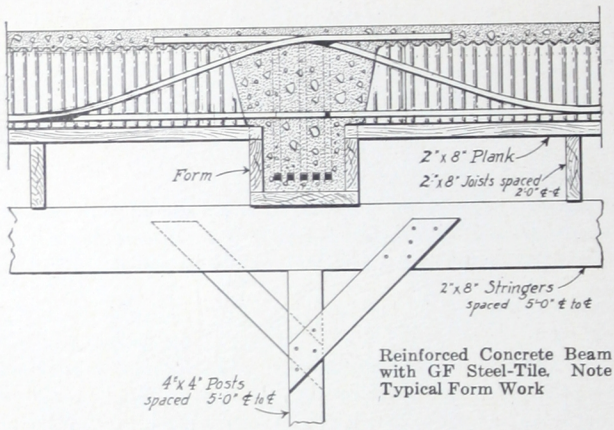
The sand used for the concrete shall be sharp graded bank or lake sand screened to pass through a ¼" screen and proportionately graded from fine to coarse, with the coarse grain predominating. All sand shall be free from loam, vegetable or other injurious matter and it shall contain not more than 4% of clay.

Stone and Gravel

The stone shall be clean crushed stone reasonably free from crusher dust, and free from loam, vegetable or other injurious matter.

The gravel shall be washed clean.

Both stone and gravel shall pass through a 1" screen and be retained on a ¼" screen.



Reinforced Concrete Beam with GF Steel-Tile. Note Typical Form Work

Steel-Tile

The Steel-Tile shall be GF Steel-Tile as manufactured by The General Fireproofing Company of Youngstown, Ohio. The Tile shall be of the sizes indicated on the drawings and must be used strictly in accordance with these specifications. The Steel-Tile shall be accurately spaced to secure the joist area called for and must be tacked securely to the centering with light nails to prevent movement while the concrete is being poured. The ceiling hangers must be placed and properly adjusted according to detail before the concrete work is commenced.

Reinforcing Steel

The reinforcing steel shall comply with the standard specifications of the American Steel Manufacturers Association. All reinforcing members shall be accurately located in the forms and secured firmly against displacement. They shall have a protection of concrete or cement mortar not less than 2" thick for hooped or plain reinforced columns and 1½" thick on the bottom and sides of girders and beams, ⅝" on the bottom of floor slabs, and 1½" on the bottom of Steel-Tile joists.

Proportion and Placing of Concrete

All concrete shall be mixed in proportion of 1 cu. ft. of cement, 2 cu. ft. of sand and 4 cu. ft. of stone. One barrel of cement shall be considered as 3.8 cu. ft. by volume. Before pouring concrete, each piece of the steel reinforcement must be thoroughly fastened in its proper place and must be held there until the pouring is completed. Concrete shall be mixed by an approved batch mixer, and must be conveyed to place in such manner that no separation of the ingredients occurs. Concrete shall be deposited before the initial set takes place and the work shall be so laid out that partially set concrete will not be disturbed by trucking or wheeling over it.

When concreting is once started, it shall be carried on as a continuous operation until the pouring of the section or panel is completed. If the concreting should be stopped, care must

be taken to stop the work at such a point that joints formed when the work is resumed will not weaken the members structurally.

All columns are to be filled at least three hours ahead of the floor construction to allow the concrete in the column to properly set up. The filling of the column must be in one continuous operation to the level of the bottom of the girder or beam supported by it.

In pouring columns the concrete is to be kept well stirred or puddled with a long pole or rod to prevent voids and honey-combing; filling the columns completely and puddling afterwards will not be allowed.

All beams shall be poured so as to be monolithic with the adjacent slab, that is, poured continuously from the bottom of the beam to the top of the slab. When fresh concrete joins concrete that is set or partially set, the exposed surface of the old concrete shall be thoroughly cleaned and be given a grout coating of neat cement before any concrete is poured.

Concrete laid during hot weather shall be thoroughly wet with clean water and be continually moistened during the first seven days after placing.

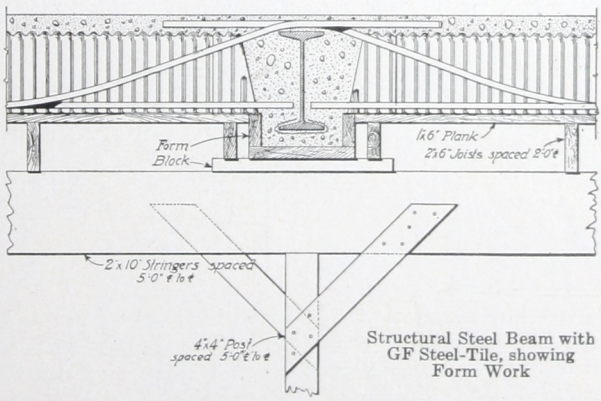
Concrete work shall not be permitted when the temperature is 32° Fahrenheit or less unless sufficient precaution is taken to prevent the concrete from freezing after having been put in place. No frozen materials shall be used.

Extreme care must be taken in the removal of forms under concrete that has been frozen, and forms shall not be removed until it is assured that the moisture has left the concrete and it has obtained its permanent set.

Forms

All forms shall be strong and rigid and sufficiently watertight to prevent leakage of mortar.

Care should be taken to insure that all debris is removed from forms and that they are thoroughly wetted before concrete is deposited in them. Column forms shall be so designed that they may be removed without disturbing the beam and slab forms, and cleanout holes shall be provided in the bottom when necessary to insure the removal of wood chips or other debris. Beam forms shall be so designed that the sides may be removed without disturbing the bottom, and on long spans this shall be given a slight camber to take care of unavoidable settlement when pouring the concrete.



Structural Steel Beam with GF Steel-Tile, showing Form Work

The time for the removal of forms shall vary with the design and with the temperature. Twenty-one days of good drying weather with a temperature above 60° shall be taken as the standard for the removal of forms carrying dead load, and three days of good drying weather with a temperature above 60° shall be taken as the standard for the removal of vertical forms carrying no dead weight. Beams and girders of 25-foot span or over shall be considered as special cases and shall be subject to the inspection of the Superintendent before removal of the support.

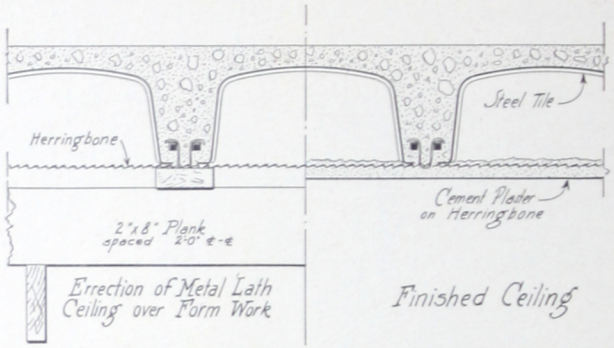
All reinforced concrete shall be carefully inspected to insure its soundness and reliability before main supports are removed.

Special care shall be taken on the removal of forms under concrete that has set and cured during freezing weather. Concrete which has been accidentally frozen during the process

of setting shall be thawed out and kept heated until it is assured that the concrete has thoroughly set. Sufficient water shall be added to the concrete during the process of thawing and setting to insure the hydration of the cement.

Loading Tests

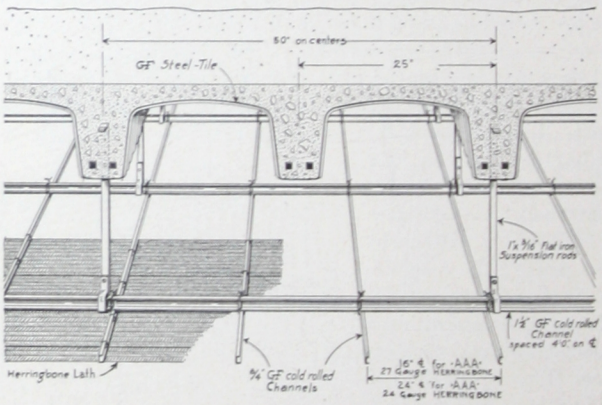
The Contractor shall at his own expense provide sufficient material and labor to make not more than two loading tests to such portions of the building as the Architect may select. Said tests must be made within a reasonable time after the forms are removed, and must show that the floors are capable of sustaining twice the figured live load without cracking or undue deflection. One month of good drying weather after removal of the forms will be taken as the proper time for the making of such tests.



Herringbone Ceiling Erected Directly on Form Work (See also page 6)

Metal Lath Ceiling

Before the concrete is poured, No. 14 Gauge tie wires shall be placed through the joists in pairs at approximately 15¾" on centers and of sufficient length to take the supporting channels for the ceiling. After the reinforced concrete is thoroughly set, the centering shall be removed and the metal lath ceiling erected.



Method of Erecting a Suspended Ceiling Under GF Steel-Tile

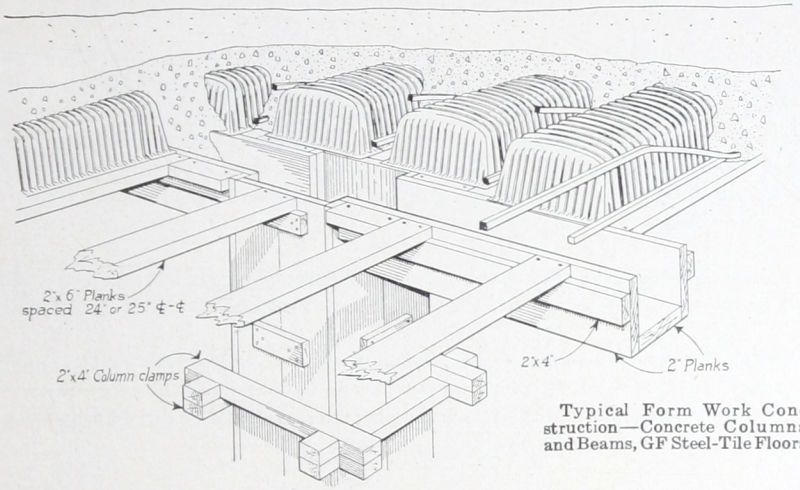
¾" GF Channel Furring shall be placed approximately 15¾" on centers, shall be securely fastened by means of the 14 Gauge wires and leveled up to the proper elevation. To this shall be wired AAA 27 Gauge Herringbone Lath, as manufactured by The General Fireproofing Company, and this Lath shall be fastened in a thorough workmanlike manner before plastering is begun.

Alternate Metal Lath Ceiling Construction

When the forms are completed and before the placing of the Steel-Tile, AAA 24 Gauge Herringbone Lath shall be placed over the forms with the ribs running at right angles to the line of the joist. The Steel-Tile and reinforcing steel shall then be placed and the Herringbone Lath wired to the reinforcing steel with 14 Gauge wire at intervals of 9". The concrete shall then be poured.

Suspended Ceiling

Where a suspended ceiling is required, 1″ x $\frac{3}{16}$″ flat hangers shall be suspended from the concrete joists spaced about 4 feet on centers, as shown on the accompanying detail. After the concrete floor is completed 1″ or 1½″ GF Cold Rolled Steel Channels shall be fastened to the bottom of the hangers and properly leveled. When this is done, wire ¾″ GF Cold Rolled Steel Channels to the underside of the 1½″ channels, spacing them 24″ on centers and under these wire securely AAA 24 Gauge Herringbone Lath with the ribs running at right angles to the line of the ¾″ channels.



Typical Form Work Construction—Concrete Columns and Beams, GF Steel-Tile Floors

State Armory, Akron, Ohio. Karl I. Best, state architect
Contractors, Clemmer & Johnson, Hicksville, Ohio

Explanations of Steel-Tile Tables

The accompanying tables are tables for safe live loads in pounds per square foot for the GF Steel-Tile Floor System. The weight of the floor slab has been deducted from the loads as given. Any additional dead loads, such as the weight of the ceiling construction or the finished floors, should also be deducted before the safe live load is obtained.

The stresses in the steel and concrete are limited to 16,000 lbs. per square inch, and 650 lbs. per square inch respectively, and the fireproofing of the reinforcement has been fixed at 1½″ from the bottom of the joist, and 1″ from the side of the joist. The distance center to center of the steel bars in each joist should never be less than two and one-half times the nominal diameter or side of bar. This spacing allows the concrete to flow freely around the reinforcing and also insures sufficient concrete to transmit the stresses from the steel to the T section of the beam.

The sizes of the bars as shown in this table are all for square bars, but round bars can very readily be substituted by reference to the tables of areas on page 30 of this Handbook.

The heavy lines shown in these tables are drawn with a vertical shearing force producing an average shearing stress of 60 lbs. per square inch on the concrete. In all cases, above and to the right of this line, the additional web shearing stresses should be cared for by using stirrups, or other suitable reinforcement.

A small amount of additional steel should always be placed in the slab at right angles to the line of the joist to prevent cracks in the concrete, due to contraction during process of setting, and to low temperatures. ¼″ or ⅜″ round rods, spaced from 18″ to 24″ on centers, depending upon the size of the floor surfaces, are commonly used for this purpose.

EXAMPLE

Let it be required to design a Steel-Tile floor with a span of 20 ft. to support a net live load of 80 lbs. per sq. ft. If the weight of the ceiling be assumed at 10 lbs. per square foot, and the weight of the floor finish at 12 lbs. per sq. ft., the total weight to be supported will be 102 lbs. per sq. ft. According to the tables, it is found that the following designs would be suitable:

Size	Bars	Strength	Dead Weight
8″ Steel-Tile plus 2″ concrete	⅞″ sq. plus ¾″ sq.	107 lbs. per sq.ft.	55 lbs. per sq.ft.
10″ Steel-Tile plus 2″ concrete	¾″ sq. plus ¾″ sq.	111 lbs. per sq.ft.	52 lbs. per sq.ft.
12″ Steel-Tile plus 2″ concrete	¾″ sq. plus ⅝″ sq.	106 lbs. per sq.ft.	70 lbs. per sq.ft.

By observing the shear line of the table, it is seen that if the 8 plus 2 or the 10 plus 2 slab is chosen, the shearing stresses in the web will be cared for by the use of stirrups, but if the 12 plus 2 slab is chosen, no stirrups will be needed. If stirrups are used, they can be calculated by reference to formula 1 on page 24. For economical design, the designer will compute the cost of the Steel-Tile, concrete and reinforcing steel in place for each thickness of slab and select the one whose sum is the least. The form work need not be taken into consideration.

NOTE: ON PAGE 27 A TYPICAL STEEL-TILE FLOOR COMPUTATION IS GIVEN TO ILLUSTRATE THE USE OF THE COMMON FORMULAS FOR REINFORCED CONCRETE DESIGN.

GF Steel-Tile

Table of Safe Live Loads in Pounds per Sq. Ft.

Depth		6″ TILE + 2″ CONCRETE							
		4″ Joists 24″ C-C Weight of Slab and Joist 46 lbs. per Sq. Ft.					5″ Joists 25″ C-C Weight of Slab and Joist 48 lbs. per Sq. Ft.		
Area of Steel		.25 Sq. In.	.39 Sq. In.	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.
Size of Square Bars		—½″	—⅝″	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″
R. M. (In Ft. Lbs.)		1030	1510	2000	2520	3040	3500	4100	4440
Length of Span in Feet	10	57	111	154	206	258	302	362	396
	11	39	84	119	162	206	242	291	318
	12		63	93	129	166	194	236	260
	13		47	72	103	134	159	194	214
	14		34	56	83	109	130	161	178
	15			43	66	89	107	134	149
	16				52	73	89	112	125
	17				41	59	73	93	105
	18					48	60	78	89
	19					38	49	66	75
	20						39	55	63
	21							45	52
	22							37	43
	23								35
	24								
	25								
	26								
	27								
	28								

Depth		8″ TILE + 2″ CONCRETE							
		5″ Joists 25″ C–C Weight of Slab and Joist 55 lbs. per Sq. Ft.							
Area of Steel		.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	
Size of Square Bars		½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	
R. M. (In Ft. Lbs.)		2540	3230	3900	4700	5510	6500	6900	
Length of Span in Feet	10	199	268	335	415	496	595	635	
	11	155	212	267	333	400	481	515	
	12	121	169	216	271	328	395	425	
	13	95	135	176	223	271	329	353	
	14	75	110	143	185	226	276	297	
	15	58	88	118	154	190	233	261	
	16	44	71	97	129	160	199	215	
	17	33	56	80	107	135	169	184	
	18		45	65	90	115	145	158	
	19		34	53	75	97	125	136	
	20			42	62	83	107	117	
	21			34	52	70	92	101	
	22				43	59	79	87	
	23				34	49	67	75	
	24					41	57	65	
	25					33	49	55	
	26						41	47	
	27						34	39	
	28							33	

GF Steel-Tile Floor Construction

GF Steel-Tile
Table of Safe Live Loads in Pounds per Sq. Ft.

Depth		10″ TILE + 2″ CONCRETE							
		5″ Joists 25″ C-C Weight of Slab and Joist 62 lbs. per Sq. Ft.							
Area of Steel		.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.
Size of Square Bars		½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″
R. M. (In Ft. Lbs.)		3180	4000	4850	5870	6910	8190	9320	9450
Length of Span in Feet	10	256	338	423	525				
	11	200	268	338	423	510			
	12	158	216	274	345	418	506		
	13	126	175	225	286	348	423	490	498
	14	100	142	186	237	291	356	414	421
	15	79	116	153	199	245	301	353	348
	16	62	94	127	168	208	258	302	308
	17	48	76	106	141	178	221	260	266
	18	37	61	88	119	152	191	226	230
	19		49	72	101	130	165	196	200
	20		38	59	85	111	143	171	174
	21			48	71	95	124	150	152
	22			38	59	81	108	130	133
	23				49	69	93	114	117
	24				40	58	80	100	102
	25					49	69	87	89
	26					40	59	76	78
	27						50	66	68
	28						42	57	59
	29							49	50
	30							42	43

Depth		12″ TILE + 2″ CONCRETE								
		5″ Joists 25″ C-C Weight of Slab and Joist 70 lbs. per Sq. Ft.								
Area of Steel		.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars		½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)		3840	4820	5850	7050	8330	9870	11240	11700	12300
Length of Span in Feet	10	314	412	515						
	11	248	328	415	514					
	12	196	264	336	420	510				
	13	157	215	276	347	424	515			
	14	126	176	228	290	355	435	505	527	
	15	100	144	190	243	300	370	430	450	477
	16	80	118	158	206	257	316	370	387	411
	17	63	97	132	174	219	272	320	335	355
	18	48	78	110	148	187	234	278	290	310
	19	36	63	92	125	161	203	242	254	271
	20		50	76	106	139	177	211	222	238
	21		39	62	90	119	154	186	196	209
	22			50	76	102	134	162	172	184
	23			40	63	88	116	142	152	162
	24				53	75	101	125	133	144
	25				43	63	88	110	117	127
	26				34	53	76	96	103	112
	27					44	66	84	90	99
	28					36	56	73	79	87
	29						47	64	69	76
	30						40	55	60	67

GF Steel-Tile

Table of Safe Live Loads in Pounds per Sq. Ft.

Depth	6″ TILE + 2½″ CONCRETE								
	4″ Joists 24″ C-C Weight of Slab and Joist 52 lbs. per Sq. Ft.					5″ Joists 25″ C-C Weight of Slab and Joist 54 lbs. per Sq. Ft.			
Area of Steel	.25 Sq. In.	.39 Sq. In.	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.
Size of Square Bars	—½″	—⅝″	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″
R. M. (In Ft. Lbs.)	1110	1700	2170	2720	3290	3780	4420	5180	5410
Length of Span in Feet 10	59	118	165	220	277	324	388	464	487
11	40	89	127	173	220	258	311	364	389
12		66	98	137	176	208	252	306	321
13		49	76	109	143	169	208	252	266
14		35	58	87	116	139	172	210	222
15			44	69	94	114	142	176	186
16				54	77	93	118	148	158
17				42	62	76	99	125	133
18					50	62	82	106	113
19					39	51	68	89	96
20					30	40	56	75	81
21							46	63	69
22							37	53	58
23								44	48
24									
25									
26									
27									
28									
29									
30									

Depth	8″ TILE + 2½″ CONCRETE							
	5″ Joists 25″ C-C Weight of Slab and Joist 61 lbs. per Sq. Ft.							
Area of Steel	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.
Size of Square Bars	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″
R. M. (In Ft. Lbs.)	2700	3390	4100	4920	5760	6810	7700	8530
Length of Span in Feet 10	209	278	349	431	515			
11	163	219	278	345	414	494		
12	127	175	223	281	339	405	474	532
13	99	139	181	231	279	337	394	444
14	77	112	147	191	233	281	331	375
15	59	88	121	157	195	237	281	319
16	45	71	99	131	164	201	239	273
17		57	81	109	137	171	205	235
18		44	65	91	117	147	177	203
19			52	75	99	125	152	175
20			41	62	83	107	131	153
21				50	70	91	114	133
22				40	58	78	98	115
23					48	66	84	101
24					39	56	72	87
25						47	62	76
26						39	53	65
27							45	56
28								48
29								40
30								

GF Steel-Tile Floor Construction

GF Steel-Tile

Table of Safe Live Loads in Pounds per Sq. Ft.

Depth		10″ TILE + 2½″ CONCRETE								
		5″ Joists 25″ C-C Weight of Slab and Joist 68 lbs. per Sq. Ft.								
Area of Steel		.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars		½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)		3320	4180	5080	6090	7180	8510	9680	11000	11350
Length of Span in Feet	10	264	350	440						
	11	206	278	352	433	524				
	12	162	222	284	354	429	524			
	13	128	180	232	292	356	437	505		
	14	100	146	191	242	298	367	427	494	510
	15	79	118	158	202	250	310	362	422	437
	16	62	95	130	170	212	264	310	362	376
	17	47	77	108	142	180	227	267	313	324
	18	34	61	89	120	153	195	231	272	282
	19		48	72	100	130	168	200	237	246
	20		36	59	84	111	145	174	207	216
	21			47	70	94	125	152	182	189
	22			37	57	80	108	132	160	166
	23				47	67	93	115	140	146
	24				38	57	80	100	123	129
	25					47	68	87	108	114
	26					38	58	75	95	100
	27						49	65	83	88
	28						41	55	73	77
	29							47	63	67
	30							40	54	58

Depth		12″ TILE + 2½″ CONCRETE								
		5″ Joists 25″ C-C Weight of Slab and Joist 76 lbs. per Sq. Ft.								
Area of Steel		.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars		½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)		3900	4960	6070	7270	8600	10100	11540	13200	14400
Length of Span in Feet	10	314	420							
	11	246	334	424						
	12	194	268	345	430	521				
	13	154	218	283	355	434	520			
	14	123	177	234	296	364	439	514		
	15	97	144	194	248	306	374	439	511	
	16	76	118	160	208	260	319	376	440	486
	17	59	96	134	176	221	274	324	381	422
	18	44	77	111	149	190	236	280	332	368
	19	32	61	92	126	162	204	244	290	322
	20		48	76	106	139	176	213	254	284
	21		37	61	89	119	155	186	224	250
	22			49	74	101	133	163	197	220
	23			39	62	86	115	142	174	196
	24				51	73	99	124	154	174
	25				41	62	85	109	135	154
	26					51	73	95	119	137
	27					42	62	82	105	120
	28					34	55	71	92	108
	29						44	62	81	95
	30						36	52	71	84

GF Steel-Tile

Table of Safe Live Loads in pounds per Sq. Ft.

Depth	6″ TILE + 3″ CONCRETE								
	4″ Joists 24″ C-C Weight of Slab and Joist 58 lbs. per Sq. Ft.				5″ Joists 25″ C-C Weight of Slab and Joist 60 lbs. per Sq. Ft.				
Area of Steel	.39 Sq. In.	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	
Size of Square Bars	—⅝″	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	
R. M. (In Ft. Lbs.)	1820	2320	2920	3540	4060	4760	5600	6050	
Length of Span in Feet 10	124	174	234	296	346	416	500		
11	93	134	183	235	276	334	402	440	
12	68	103	145	188	222	270	329	360	
13	50	79	114	152	180	222	272	298	
14	35	60	91	123	148	182	225	248	
15		45	72	100	120	152	188	209	
16		32	56	80	99	126	158	176	
17			43	65	81	105	134	150	
18				52	66	87	113	127	
19				41	53	72	95	108	
20					42	59	80	91	
21						48	67	77	
22						39	55	65	
23							46	54	
24							37	45	
25									
26									
27									
28									
29									
30									

Depth	8″ TILE + 3″ CONCRETE								
	5″ Joists 25″ C-C Weight of Slab and Joist 67 lbs. per Sq. Ft.								
Area of Steel	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)	2860	3580	4340	5220	6120	7160	8160	9250	9770
Length of Span in Feet 10	219	291	367	455					
11	169	229	291	364	438	526			
12	131	182	233	295	358	432	502		
13	102	145	189	242	295	358	418	480	511
14	79	115	155	199	245	299	351	405	431
15	60	91	126	165	205	251	297	343	367
16	45	73	102	137	172	213	253	294	315
17	32	57	83	114	145	181	218	253	271
18		43	67	94	121	155	185	218	234
19		32	53	78	102	131	161	189	203
20			41	63	86	112	138	164	177
21			31	51	71	96	119	143	154
22				41	59	81	102	124	135
23				32	48	68	88	108	118
24					39	58	75	93	103
25					31	48	64	81	89
26						39	54	69	77
27						31	45	60	67
28							37	51	58
29							30	43	49
30								36	42

GF Steel-Tile

Table of Safe Live Loads in Pounds per Sq. Ft.

Depth		10″ TILE + 3″ CONCRETE								
		5″ Joists 25″ C-C Weight of Slab and Joist 74 lbs. per Sq. Ft.								
Area of Steel		.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars		½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)		3460	4330	5220	6350	7440	8800	10020	11500	12800
Length of Span in Feet	10	272	359	448						
	11	212	284	357	451					
	12	166	226	288	367	442	538			
	13	131	182	235	302	366	447	521		
	14	102	147	192	250	305	376	439	512	
	15	80	118	158	208	256	317	372	436	494
	16	61	96	130	174	216	270	319	376	426
	17	46	76	107	146	183	231	274	324	368
	18	33	59	87	122	156	198	236	281	322
	19		46	71	102	132	170	204	245	281
	20		34	56	85	112	146	176	213	246
	21			44	70	94	126	154	187	216
	22			34	57	80	108	134	164	190
	23				46	66	93	116	144	168
	24				36	55	79	100	126	148
	25					45	67	87	110	131
	26					36	56	75	96	116
	27						46	65	84	102
	28						38	54	73	89
	29							46	63	78
	30							38	54	68

Depth		12″ TILE + 3″ CONCRETE								
		5″ Joists 25″ C-C Weight of Slab and Joist 82 lbs. per Sq. Ft.								
Area of Steel		.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars		½″ + ½″	⅝″ + ¾″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)		4080	5140	6250	7500	8830	10520	11920	13700	15580
Length of Span in Feet	10	326	432	543						
	11	255	342	434	538					
	12	202	274	353	438	530				
	13	160	221	288	362	440	542			
	14	126	180	237	300	368	455	528		
	15	99	146	196	252	310	387	448	526	
	16	77	118	162	210	262	329	384	453	527
	17	59	95	134	178	223	282	331	392	458
	18	44	76	111	150	190	243	287	341	400
	19	31	60	91	126	162	210	249	298	350
	20		46	74	105	139	181	216	260	307
	21		34	60	88	118	157	189	228	271
	22			47	73	101	136	165	200	240
	23			36	60	85	116	144	177	212
	24			26	48	72	101	125	156	189
	25				38	59	86	109	137	168
	26				29	49	74	95	121	148
	27					39	62	82	106	132
	28					31	52	70	93	117
	29						43	60	81	103
	30						35	50	70	91

GF Steel-Tile

Table of Safe Live Loads in Pounds per Sq. Ft.

Depth	6″ TILE + 3½″ CONCRETE								
	5″ Joists 25″ C-C Weight of Slab and Joist 66 lbs. per Sq. Ft.								
Area of Steel	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)	2380	3010	3640	4340	5070	6000	6780	6970	7270
Length of Span in Feet 10	172	235	298	368	441				
11	131	183	235	292	354	429	494	510	535
12	99	143	187	234	286	350	405	419	440
13	75	112	150	190	234	289	335	347	365
14	57	88	120	155	192	240	280	290	306
15	41	68	96	127	160	200	235	244	258
16		52	76	103	132	168	198	206	218
17		38	60	84	109	142	168	176	186
18			46	68	90	119	143	150	159
19			35	54	74	100	122	127	136
20				42	61	84	103	108	116
21					49	70	87	92	99
22					39	58	74	78	84
23						47	62	66	72
24						38	52	55	61
25							42	46	51
26									42
27									
28									
29									
30									

Depth	8″ TILE + 3½″ CONCRETE								
	5″ Joists 25″ C-C Weight of Slab and Joist 73 lbs. per Sq. Ft.								
Area of Steel	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)	3020	3800	4590	5500	6430	7570	8600	9870	10650
Length of Span in Feet 10	229	307	386	477					
11	177	241	305	382	457	552			
12	137	191	245	309	372	452	524		
13	106	151	198	253	307	374	437	512	557
14	81	121	161	208	255	313	367	432	470
15	61	96	131	171	213	263	309	366	400
16	45	75	106	141	177	223	263	313	343
17	32	58	86	117	149	189	224	269	295
18		44	68	97	125	161	193	231	256
19		32	54	79	105	137	165	200	222
20			42	64	88	116	142	174	193
21			31	52	73	99	122	151	169
22				41	60	83	104	131	147
23				31	48	70	89	113	129
24					38	58	76	98	112
25						48	65	85	97
26						39	54	73	85
27							45	62	73
28							37	53	63
29								44	53
30								37	45

GF Steel-Tile

Table of Safe Live Loads in Pounds per Sq. Ft.

Depth	10″ TILE + 3½″ CONCRETE								
	5″ Joists 25″ C-C Weight of Slab and Joist 80 lbs. per Sq. Ft.								
Area of Steel	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)	3580	4600	5550	6650	7800	9210	10420	11900	13500
Length of Span in Feet									
10	278	380	475						
11	216	300	380	470					
12	168	239	305	381	462	560			
13	132	192	249	314	381	465	540		
14	103	154	203	259	318	390	454	527	610
15	79	124	166	216	266	330	385	449	520
16	60	100	138	180	224	280	328	385	446
17	44	79	112	150	190	239	281	332	387
18	31	62	91	125	161	204	242	288	336
19		47	73	104	136	175	210	250	294
20		35	59	86	115	150	181	217	257
21			46	71	97	128	156	190	226
22			35	57	81	110	136	166	198
23				46	67	94	117	145	175
24				35	56	80	101	126	154
25					45	67	87	110	136
26					35	56	74	96	120
27						46	63	83	105
28						37	53	72	92
29							44	62	80
30							36	52	70

Depth	12″ TILE + 3½″ CONCRETE								
	5″ Joists 25″ C-C Weight of Slab and Joist 88 lbs. per Sq. Ft.								
Area of Steel	.50 Sq. In.	.64 Sq. In.	.78 Sq. In.	.95 Sq. In.	1.12 Sq. In.	1.34 Sq. In.	1.53 Sq. In.	1.76 Sq. In.	2.00 Sq. In.
Size of Square Bars	½″ + ½″	⅝″ + ½″	⅝″ + ⅝″	¾″ + ⅝″	¾″ + ¾″	⅞″ + ¾″	⅞″ + ⅞″	1″ + ⅞″	1″ + 1″
R. M. (In Ft. Lbs.)	4250	5350	6500	7770	9120	10820	12500	14050	15950
Length of Span in Feet									
10	337	447	562						
11	264	354	450	552					
12	208	284	362	451	547				
13	164	228	296	372	452	552			
14	129	184	244	308	378	465	549		
15	101	150	201	256	317	394	467	537	
16	78	121	166	215	268	336	400	462	536
17	59	97	136	180	227	286	344	398	465
18	43	77	112	151	194	246	298	347	405
19	30	60	92	127	164	212	258	302	354
20		46	74	106	140	182	224	263	310
21		33	59	88	118	158	196	231	274
22			46	72	101	136	170	202	242
23			35	58	84	117	148	178	214
24				47	70	100	128	156	189
25				36	58	85	112	137	168
26					47	73	97	120	148
27					37	61	83	105	131
28						50	72	92	116
29						41	60	79	102
30						32	51	68	89

Length and Number of GF Steel-Tile for Various Spans

Clear Span	30″ Tile number required	35″ Tile number required	End Caps number required	Clear Span	30″ Tile number required	35″ Tile number required	End Caps number required
10′–0″	4	0	2	20′–0″	0	7	2
10′–3″	3	1	2	20′–3″	6	2	2
10′–6″	3	1	2	20′–6″	5	3	2
10′–9″	2	2	2	20′–9″	4	4	2
11′–0″	1	3	2	21′–0″	4	4	2
11′–3″	1	3	2	21′–3″	3	5	2
11′–6″	0	4	2	21′–6″	3	5	2
11′–9″	0	4	2	21′–9″	2	6	2
12′–0″	5	0	2	22′–0″	2	6	2
12′–3″	5	0	2	22′–3″	1	7	2
12′–6″	4	1	2	22′–6″	0	8	2
12′–9″	4	1	2	22′–9″	0	8	2
13′–0″	3	2	2	23′–0″	6	3	2
13′–3″	3	2	2	23′–3″	5	4	2
13′–6″	2	3	2	23′–6″	4	5	2
13′–9″	2	3	2	23′–9″	4	5	2
14′–0″	1	4	2	24′–0″	3	6	2
14′–3″	0	5	2	24′–3″	3	6	2
14′–6″	0	5	2	24′–6″	2	7	2
14′–9″	6	0	2	24′–9″	1	8	2
15′–0″	5	1	2	25′–0″	1	8	2
15′–3″	4	2	2	25′–3″	0	9	2
15′–6″	4	2	2	25′–6″	0	9	2
15′–9″	3	3	2	25′–9″	6	4	2
16′–0″	3	3	2	26′–0″	5	5	2
16′–3″	2	4	2	26′–3″	5	5	2
16′–6″	1	5	2	26′–6″	4	6	2
16′–9″	1	5	2	26′–9″	3	7	2
17′–0″	0	6	2	27′–0″	3	7	2
17′–3″	0	6	2	27′–3″	2	8	2
17′–6″	6	1	2	27′–6″	1	9	2
17′–9″	5	2	2	27′–9″	1	9	2
18′–0″	4	3	2	28′–0″	0	10	2
18′–3″	4	3	2	28′–3″	0	10	2
18′–6″	3	4	2	28′–6″	6	5	2
18′–9″	3	4	2	28′–9″	5	6	2
19′–0″	2	5	2	29′–0″	4	7	2
19′–3″	1	6	2	29′–3″	4	7	2
19′–6″	1	6	2	29′–6″	3	8	2
19′–9″	0	7	2	29′–9″	3	8	2
				30′–0″	2	9	2

GF Steel-Tile Floor Construction

Properties of Steel-Tile Floors

2″ OF CONCRETE ABOVE STEEL-TILE

Width of Joists in Inches	Center to Center of Joists in Inches	Size Steel-Tile	6″	8″	10″	12″
		Aver'ge weight per square foot	45.8	51.6	58.5	65.6
		Cu. ft. of Concrete per sq. ft. of floor	.310	.352	.398	.447
4	24	Core Area % of Section	54.2	58.4	60.8	62.2
		Aver'ge weight per square foot	47.9	54.5	62.0	69.9
		Cu. ft. of Concrete per sq. ft. of floor	.325	.372	.423	.477
5	25	Core Area % of Section	52.0	56.0	58.3	59.7

3″ OF CONCRETE ABOVE STEEL-TILE

Width of Joists in Inches	Center to Center of Joists in Inches	Size Steel-Tile	6″	8″	10″	12″
		Aver'ge weight per square foot	57.8	63.5	70.5	77.6
		Cu. ft. of Concrete per sq. ft. of floor	.394	.435	.481	.531
4	24	Core Area % of Section	48.2	53.1	56.0	58.0
		Aver'ge weight per square foot	59.9	66.5	74.0	81.9
		Cu. ft. of Concrete per sq. ft. of floor	.410	.455	.505	.559
5	25	Core Area % of Section	46.3	50.9	53.9	55.7

2½″ OF CONCRETE ABOVE STEEL-TILE

Width of Joists in Inches	Center to Center of Joists in Inches	Size Steel-Tile	6″	7″	10″	12″
		Aver'ge weight per square foot	51.8	57.6	64.5	71.6
		Cu. ft. of Concrete per sq. ft. of floor	.351	.394	.438	.488
4	24	Core Area % of Section	51.0	55.6	58.2	60.0
		Aver'ge weight per square foot	53.9	60.5	68.0	75.9
		Cu. ft. of Concrete per sq. ft. of floor	.369	.413	.464	.518
5	25	Core Area % of Section	49.0	53.4	55.9	57.6

3½″ OF CONCRETE ABOVE STEEL-TILE

Width of Joists in Inches	Center to Center of Joists in Inches	Size Steel-Tile	6″	8″	10″	12″
		Aver'ge weight per square foot	63.8	69.6	76.5	83.6
		Cu. ft. of Concrete per sq. ft. of floor	.435	.477	.524	.572
4	24	Core Area % of Section	45.8	51.0	54.1	56.3
		Aver'ge weight per square foot	65.9	72.5	80.0	87.9
		Cu. ft. of Concrete per sq. ft. of floor	.451	.497	.547	.601
5	25	Core Area % of Section	44.0	49.0	51.6	54.0

Steel-Tile are Economically Shipped

The tables of weight below show conclusively the economy in shipping Steel-Tile as well as handling it on the job.

Both the Steel-Tile and the End-Tile nest snugly, taking up the minimum space, and stacks are of such shape that the crates are easily handled.

A tapered rod serves to separate the Steel-Tile when needed and it is good practice to keep them stacked until ready to use.

Width of Steel-Tile at bottom, exclusive of flange, 20″.

STEEL-TILE

Size	Approx. Weight Per 100 Pieces		Weight Per 100 Lineal Feet
	30″ long	35″ long	
6″	430	500	171
8″	470	550	188
10″	610	710	243
12″	660	770	264

END-TILE

Size	Approx. Weight Per 100 Pieces
6″	130
8″	160
10″	190
12″	230

General Theory and Working Formulas for Reinforced Concrete

This article is not intended as an elementary treatise on Reinforced Concrete, but rather to show the application of the general theory and formulas on which the foregoing tables are based. It is assumed that those who use this Handbook understand the general principles underlying Reinforced Concrete design.

The accompanying formulas and computations are based on the following assumptions:

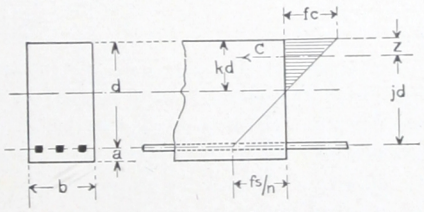
1. The adhesion between the concrete and steel is sufficient to make the two materials act together.
2. The Stress Strain curve for concrete in compression is a straight line.
3. The concrete carries no direct tension.
4. The ratio of the Modulus of Elasticity of Steel to that of 1:2:4 Concrete is 15.

The sketches illustrate graphically the principles embodied in the above assumptions.

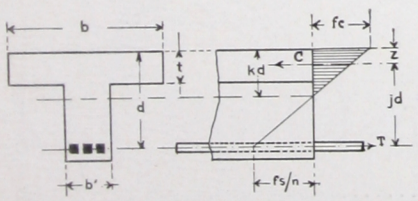
The following notations have been used throughout this Handbook.

Beams and Slabs

f_s = the unit fiber stress of the steel.
f_c = the unit fiber stress of the concrete.
E_s = the modulus of elasticity of the steel.
E_c = the modulus of elasticity of the concrete in compression.
n = the ratio of $E_s \div E_c$.
T = the total tension in the steel at a section of the beam or slab.
C = the total compression on the concrete at a section of the beam or slab.
M = the bending moment in inch-pounds.
M_s = the moment of resistance of the steel in inch-pounds.
M_c = the moment of resistance of concrete in inch-pounds.
b = in inches the breadth of a rectangular beam or slab under consideration, or the width of flange of a T beam.
b′ = the width of stem of a T beam in inches.



Stress in Rectangular Beam



Stress in T Beam

d = the distance from the top of the compressive face of the concrete to the center of gravity of the steel.
k = the ratio of depth of the neutral axis to the effective depth d.
= the ratio of lever arm of resisting couple to depth d.
A_s = the cross-sectional area of steel.

p = the percentage of steel—equal to $\frac{A_s}{bd}$

z = the distance from top of concrete to the centroid of compression area.

jd = the arm of the resisting couple in inches; = d-z.

Shear

V = Total Vertical Shear at given section.

v = $\frac{V}{bjd}$ = unit Vertical Shear at given section in lbs. per sq. in.

v′ = v-60 = Shear in lbs. per sq. in. carried by Stirrups.

A_v = Sect. Area of one Stirrup Rod in sq. in.

S = Horizontal Spacing in inches of Stirrups at given section.

Bending Moments

Slabs and girders continuous over supports act as continuous beams and must be provided with reinforcing at these points to take care of the negative bending moment. Provision for the negative bending moment over the supports materially reduces the positive bending moment at the center of span. It is considered good practice to use the following values:

Freely supported at both ends.....M = 1/8 Wl

Freely supported at one end, and continuous at the other.....M = 1/10 Wl

Continuous over both supports.....M = 1/12 Wl

W = total load on the slab or beam under consideration.

l = span in feet if M is to be expressed in foot-pounds.

l = span in inches if M is to be expressed in inch-pounds.

Shear

Anything like a thorough analysis of shearing stresses would be far beyond the scope of this Handbook. Therefore, we will proceed on the assumption that the concrete is capable of resisting a unit shearing stress of 60 pounds per square inch, and that any shear in excess of this amount must be taken up by vertical stirrups.

Allowing a unit shearing stress in the steel of 12000 pounds per square inch, we have for the required horizontal spacing of the stirrups at any given section:

$$S = \frac{2A_v \times 12000}{bv} \quad \ldots\ldots (1)$$

For beams uniformly loaded, stirrups should in general be spaced at "S" inches on centers for a distance from the support equal to about one-sixth of the span. From this point the spacing should be gradually increased for another one-sixth span. Stirrups spaced farther apart than a distance equal to jd cannot be considered effective, but may be employed as an aid in holding the main beam reinforcement.

Formulas

Rectangular Beams and Slabs

Location of neutral axis— $kd = (\sqrt{2pn + (pn)^2} - pn)d$ ..... (2)

Arm of Resisting Couple— $jd = (1 - \frac{1}{3}k)\ d$ ..... (3)

Fiber Stresses— ..... $f_s = \frac{M}{A_s jd} = \frac{M}{pjbd^2}$ ..... (4)

$f_c = \frac{2M}{jkbd^2} = \frac{2pf_s}{k}$ ..... (5)

Percentage of Steel— $p = \frac{A_s}{bd}$ ..... (6)

For Balanced Reinforcement— $p = \frac{\frac{1}{2}}{\frac{f_s}{f_c}\left(\frac{f_s}{nf_c} + 1\right)}$ ..... (7)

(By "Balanced Reinforcement" is meant the percentage of steel at which both steel and concrete are working at the allowable unit stresses.)

Depth "d" $d = \sqrt{\frac{M}{Rb}}$ in which $R = f_s pj$ ..... (8)

For 12" width of slab or rectangular beam, assuming $f_s = 16000$ and $f_c = 650$,

$d = .028\sqrt{M}$ ..... (9)

Steel required $A_s = \frac{M}{jdf_s} = pbd$ ..... (10)

Formulas for T Beams

If the Neutral Axis falls in the Flange, use the foregoing formulas for Rectangular Beams; if in the Stem, the following will apply:

Location of Neutral Axis— $kd = \frac{2ndA_s + bt^2}{2nA_s + 2bt}$ ..... (11)

Location of Resultant Compression— $z = \frac{t(3kd - 2t)}{3(2kd - t)}$ ..... (12)

Arm of Resisting Couple— $jd = d - z$ ..... (13)

Fiber Stresses— $f_c = \frac{Mkd}{bt\,(kd - \frac{1}{2}t)\,jd}$ ..... (14)

$f_s = \frac{M}{A_s jd}$ ..... (15)

Approximate formula— $T = \frac{M}{d - \frac{1}{2}t}$ ..... (16)

Stayed Columns

Notation

P = safe load or total vertical load.
f_c = allowable unit stress for concrete in direct compression.
A_c = total cross sectional area of concrete in compression.
n = E_s/E_c = 15.
A_s = total cross sectional area of vertical steel.

$P = f_c\ [A_c + nA_s]$ ..... (17)

Hooped Columns

Notation

P = safe load or total vertical load.
f_c = allowable unit stress in the concrete within the hooping.
A_c = cross sectional area of the concrete within the hooping.
n = E_s/E_c = 15.
A_s = total cross sectional area of vertical steel.
A'_s = cross sectional area of one rod of hooping.
h = inside diameter of hooping.
f_s = allowable unit tension for hooping steel.
s = pitch or vertical spacing of spiral hooping.

$P = \left(A_c + nA_s\right)\left(f_c + 4.8\,\frac{f_s/s \times A'_s}{h}\right)$ ..... (18)

Reinforced Concrete Footings

With but slight variation the design of reinforced concrete footings follows the principles and formulas already laid down for rectangular beams and slabs.

The design of the footing illustrated below is based on the following assumptions:

1. The load is transmitted from the column to the footing along lines a,a, having a slope of 1:3 and extending from every point in the perimeter of the column to the base of the footing.

2. The load is carried to the soil by two cross girders whose effective depth = d; length = B and width = b.

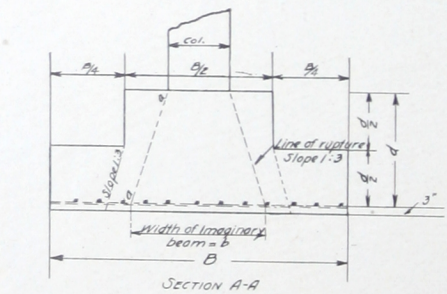
3. The load causing the bending moment in each of these cantilever cross girders is equal to ¼ of the load obtained by deducting the load on the area b×b from the total column load.

4. This load acts with a lever arm L.

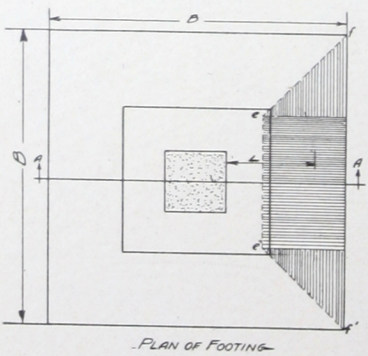
The problem, therefore, is simply to proportion the cantilever cross girders to resist the bending moment set up by this load.

Notation

A = required area of footing in square feet.
W = total column load in pounds.
S = allowable soil pressure in pounds per square foot.
P = ¼ of load carried by footing outside the line of rupture.
= load on area efe'f'.
L = distance from side of column to center of gravity of area efe'f'.



SECTION A-A



PLAN OF FOOTING

$$A = \frac{W}{S} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (19)$$

$$M = PL \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (20)$$

To find the required depth of footing and the amount of steel reinforcement, apply the formulas for rectangular beams.

Footings should be so proportioned that the shear on any plane of rupture shall not exceed 30 pounds per square inch.

Computation of GF Steel-Tile Slab Using Formulas

Span 20′-0″ L. L. 80 lbs. $f_s = 16000$ $f_c = 650$ $n = 15$.

Assume 12″ GF Steel-Tile and 2″ Conc. Slab. Joists 25″ on centers. (5″ wide at bottom.)

$d = 12\frac{1}{2}''$.

Load on 1 Joist:

Live Load—	80 lbs. per Sq. Ft.
Slab and Joist—	70 lbs. per Sq. Ft.
Flr. Finish—	12 lbs. per Sq. Ft.
Ceiling—	10 lbs. per Sq. Ft.
	172 lbs. per Sq. Ft. × 2.08 = 358 lbs. per Lin. Ft. of Joist.

Total Load on 1 Joist = 358 x 20 = 7160 lbs.

$$M = \frac{7160 \times 20 \times 12}{10} = 172000 \text{ inch Lbs.}$$

From Formula (10) $A_s = \frac{172000}{11.5 \times 16000} = .93$ Sq. Inches.

(In which $11\frac{1}{2}$″ is Approx. Lever Arm = $d - \frac{1}{2}t$)

From Formula (11) We Have $kd = \frac{2 \times 15 \times 13 \times .93 + 25 \times 4}{2 \times 15 \times .93 + 2 \times 25 \times 2} = 3.62''$.

As Kd is Greater Than 2″, The Neutral Axis is in the Web, and T Beam Formula Applies

From Formula (12) $z = \frac{2\,(3 \times 3.62 - 4)}{3\,(2 \times 3.62 - 2)} = .87$

From Formula (13) jd = 12.50 — .87 = 11.63.

Actual Steel Req'd—Formula (10) $A_s = \frac{172000}{11.63 \times 16000} = .924$ Sq. Inches.

Use— $1 - \frac{3}{4}''$ sq. Bar = .56 Sq. Inches.
$1 - \frac{5}{8}''$ sq. Bar = .39 Sq. Inches.
.95 Sq. Inches.

From Formula (14) $f_c = \frac{172000 \times 3.62}{24 \times 2 \times 2.62 \times 11.63} = 409$ lbs. Per Sq. In. Which is Well Below the 650 lbs. Allowed.

Maximum End Shear = $\frac{1}{2}$ Total Load on Joist = 3580 Lbs.

Unit Shear = $\frac{3580}{11.63 \times 6} = 51.3$ Lbs. per Sq. Inch.

(6″ = Average Thickness Of Joist)

Table of Weights of Materials and Loads in Storage Warehouses

MATERIAL	Weights per cu. ft. of space Pounds	Weights per sq. ft. of floor Pounds	Recommended live loads in lbs. per sq. ft.
GROCERIES, WINES, LIQUORS, ETC.			
Beans in bags	40	320	250 to 300
Canned goods in cases	58	348	250 to 300
Coffee in bags	39	312	250 to 300
Flour	40	200	250 to 300
Molasses	48	240	250 to 300
Rice	58	348	250 to 300
Salt in bags	70	350	250 to 300
Sugar in barrels	43	215	250 to 300
Tea in chests	25	200	250 to 300
Wines and liquors in barrels	38	228	250 to 300
DRY GOODS—COTTON, WOOL, ETC.			
Burlap in bales	43	258	200 to 250
Cotton in bales, compressed	18	144	200 to 250
Cotton goods in cases	28	224	200 to 250
Hemp, manila	30	240	200 to 250
Jute	41	328	200 to 250
Linen goods	30	240	200 to 250
Wool in bales, not compressed	13	104	200 to 250
Wool in bales, compressed	48	104	200 to 250
Woolen goods in cases	27	216	200 to 250
BUILDING MATERIALS, HARDWARE, ETC.			
Portland Cement	73	438	300 to 400
Small Hardware	30 to 65	300 to 400	300 to 400
Sheet Tin in boxes	278	556	300 to 400
Wire coils	75	450	300 to 400
DRUGS, PAINTS, OILS, ETC.			
Alum in barrels	33	198	200 to 300
Glycerine in cases	52	312	200 to 300
Linseed oil in drums	45	180	200 to 300
Rosin in barrels	48	288	200 to 300
Soda, caustic, in iron drums	88	294	200 to 300
Sulphuric acid	60	100	200 to 300
White lead in cans	174	610	200 to 300
White lead, dry	86	408	200 to 300
Red lead and Litharge	132	495	200 to 300
MISCELLANEOUS			
Glass and chinaware in crates	40	320	300
Hides and leather	20	160	300
Paper, newspaper and straw board	35	210	300
Paper, writing	60	360	300
Rope in coils	32	192	300

NOTE—The figures in the column under weights per sq. ft. of floor are based on the height to which it is convenient and practicable to pile the different kinds of material, viz.: Beans in bags can be piled to 8′, salt to 5′, cement to 6′, etc.

Rectangular Wooden Beams

One Inch Thick
Allowable Uniform Load in Pounds
American Railway Engineering Assn. Formulas

Span in Feet	Depth of beam—inches								
	2	4	6	8	10	12	14	16	18
2	267								
3	178								
4	133	533							
5	107	427							
6	89	356	800						
7	76	305	686						
8	67	267	600	1067					
9		237	533	948					
10		213	480	853	1333				
11		194	436	776	1212	1745			
12		178	400	711	1111	1600			
13			369	656	1026	1477	2010		
14			343	610	952	1371	1867		
15			320	569	889	1280	1742	2276	
16			300	533	833	1200	1633	2133	
17				502	784	1129	1537	2008	2541
18				474	741	1067	1452	1896	2400
19				449	702	1011	1375	1796	2274
20				427	667	960	1307	1707	2160
21					635	914	1244	1625	2057
22					606	873	1188	1552	1964
23					580	835	1136	1484	1878
24					556	800	1089	1422	1800
25						768	1045	1365	1728

The above table is for Douglas Fir. To obtain allowable uniform load for Longleaf Pine, add 1/12th or 8% to above figures. For Shortleaf Pine, Hemlock or White Oak deduct 1/12th or 8% from above figures. For White Pine deduct 1/4th or 25%.

Square Wooden Columns

Safe Loads in Thousands of Pounds

	Length	Side of Square—Inches								
	Feet	4	6	8	10	12	14	16	18	20
	6	14.6								
Longleaf	8	12.5	34.3							
Pine and	10	10.4	31.2	62.4						
White	12		28.1	58.2						
Oak	14			54.1	93.6					
	16			49.9	88.4	137.3				
	18			45.8	83.2	131.0	189.3			
	20			41.6	78.0	124.8	182.0	250.0	316.0	390.0
	6	13.4								
Douglas	8	11.5	31.7							
Fir and	10	9.6	28.8	57.6						
Western	12		25.9	53.8						
Hemlock	14		23.0	49.9	86.4					
	16			46.1	81.6	126.7				
	18			42.2	76.8	121.	174.7			
	20			38.4	72.0	115.2	168.0	230.4	291.6	360.0

To obtain Safe Load on Shortleaf Pine or Spruce Columns deduct 7% from table for Douglas Fir. For White Pine or Tamarack deduct 15%.

Weight and Area of Square and Round Bars

Size inches	Weight in Lbs. per foot		Area in square inches		Size inches	Weight in Lbs. per foot		Area in square inches	
	□	○	□	○		□	○	□	○
1/4″	.213	.167	.0625	.0491	11/16″	1.607	1.262	.4727	.3712
5/16″	.332	.261	.0977	.0767	3/4″	1.913	1.502	.5625	.4418
3/8″	.478	.376	.1406	.1105	13/16″	2.245	1.763	.6602	.5185
7/16″	.651	.511	.1914	.1503	7/8″	2.603	2.044	.7656	.6013
1/2″	.850	.668	.2500	.1963	15/16″	2.988	2.347	.8789	.6903
9/16″	1.076	.845	.3164	.2485	1″	3.400	2.670	1.0000	.7854
5/8″	1.328	1.043	.3906	.3068					

Table No. 14

Cubic Yards Concrete Required for Beams, Columns and Slabs

CUBIC YARDS OF CONCRETE FOR BEAMS
100 FT. LONG

DEPTH	Width 4 Inch	5 Inch	6 Inch	7 Inch	8 Inch	9 Inch	10 Inch	11 Inch	12 Inch
4″	.412								
5″	.515	.643							
6″	.617	.772	.926						
7″	.720	.900	1.080	1.260					
8″	.823	1.029	1.235	1.440	1.646				
9″	.926	1.157	1.389	1.620	1.852	2.083			
10″	1.029	1.286	1.543	1.801	2.058	2.315	2.572		
11″	1.132	1.415	1.697	1.981	2.263	2.546	2.829	3.112	
12″	1.235	1.543	1.852	2.161	2.469	2.778	3.086	3.395	3.704
13″	1.337	1.672	2.006	2.340	2.675	3.009	3.343	3.677	4.012
14″	1.440	1.801	2.161	2.521	2.881	3.241	3.601	3.961	4.321
15″	1.543	1.929	2.315	2.701	3.086	3.472	3.858	4.244	4.630
16″	1.646	2.058	2.468	2.881	3.292	3.704	4.115	4.526	4.936
17″	1.749	2.186	2.624	3.061	3.498	3.935	4.373	4.810	5.247
18″	1.852	2.315	2.778	3.241	3.704	4.167	4.630	5.093	5.555
19″	1.955	2.443	2.932	3.421	3.909	4.398	4.887	5.376	5.864
20″	2.058	2.572	3.086	3.601	4.115	4.630	5.144	5.658	6.173
21″	2.161	2.701	3.240	3.781	4.321	4.861	5.402	5.941	6.482
22″	2.263	2.829	3.394	3.961	4.526	5.093	5.659	6.224	6.790
23″	2.366	2.958	3.549	4.141	4.732	5.324	5.916	6.507	7.099
24″	2.469	3.086	3.704	4.321	4.938	5.555	6.173	6.790	7.408
25″	2.572	3.215	3.858	4.501	5.143	5.786	6.429	7.072	7.716
26″	2.674	3.343	4.012	4.680	5.349	6.018	6.686	7.358	8.023
27″	2.778	3.472	4.167	4.861	5.556	6.249	6.944	7.638	8.333
28″	2.881	3.601	4.321	5.041	5.761	6.481	7.202	7.922	8.642
29″	2.984	3.729	4.475	5.221	5.967	6.713	7.459	8.205	8.951
30″	3.086	3.858	4.630	5.401	6.173	6.944	7.716	8.488	9.259
31″	3.189	3.987	4.784	5.581	6.379	7.176	7.974	8.770	9.568
32″	3.292	4.115	4.938	5.761	6.584	7.407	8.230	9.053	9.876
33″	3.395	4.244	5.091	5.941	6.790	7.639	8.487	9.336	10.18
34″	3.498	4.372	5.248	6.122	6.996	7.870	8.745	9.619	10.49
35″	3.601	4.501	5.401	6.301	7.201	8.101	9.002	9.902	10.80
36″	3.704	4.630	5.555	6.481	7.407	8.333	9.259	10.19	11.11

COLUMNS					SLABS		
	SQUARE		ROUND				
Side of Square or Diam. of Round	Cubic Yds. per Ft. Height	Weight per Ft. Height and Area Section	Cubic Yds. per Ft. Height	Weight per Ft. Height and Area Section	Thickness	Cubic Yds. Per 100 Sq. Ft.	Weight Per Sq. Ft.
6″	.009	36					
7″	.013	49			2″	.6175	24
8″	.016	64			2½	.7715	30
9″	.021	81			3″	.926	36
10″	.026	100					
11″	.031	121			3½	1.080	42
12″	.037	144	.029	113.1			
13″	.043	169	.034	132.7	4″	1.235	48
14″	.050	196	.040	153.9			
15″	.058	225	.045	176.7	4½	1.389	54
16″	.066	256	.052	201.1			
17″	.074	289	.058	227.0	5″	1.543	60
18″	.083	324	.065	254.5			
19″	.093	361	.073	283.5	5½″	1.698	66
20″	.103	400	.081	314.2			
21″	.113	441	.089	346.4	6″	1.852	72
22″	.124	484	.098	380.1			
23″	.136	529	.107	415.5	6½	2.006	78
24″	.148	576	.116	452.4			
25″	.160	625	.126	490.9	7″	2.161	84
26″	.174	676	.136	530.9			
27″	.187	729	.147	572.6	7½	2.315	90
28″	.201	784	.158	615.8	8″	2.469	96
29″	.216	841	.170	660.5	8½	2.624	102
30″	.231	900	.182	706.9	9″	2.778	108
31″	.247	961	.194	754.8	9½	2.932	114
32″	.263	1024	.207	804.2	10″	3.086	120
33″	.280	1089	.220	855.3	10½	3.241	126
34″	.292	1156	.233	907.9	11″	3.396	132
35″	.315	1225	.247	962.1	11½	3.550	138
36″	.333	1296	.262	1017.9	12″	3.704	144

The General Fireproofing Company

Table No. 16

Quantities of Materials for One Cubic Yard of Rammed Concrete Based on a Barrel of 3.8 Cubic Feet

(Reprinted by permission from Taylor & Thompson's "Concrete, Plain and Reinforced," page 231)

Proportions by Parts			Proportions by Volumes			Volume of Mortar in Terms of Percentage of Volume of Stone	Percentages of Voids in Broken Stone or Gravel														
							50%*			45%†			40%‡			30%§			20%§		
Cement	Sand	Stone	Packed Cement	Loose Sand	Loose Stone		Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
			bbl.	cu. ft.	cu. ft.		bbl.	cu. yd.	cu. yd.	bbl.	cu. yd.	cu. yd.	bbl.	cu. yd.	cu. yd.	bbl.	cu. yd.	cu. yd.	bbl.	cu. yd.	cu. yd.
1	....	1	1	....	3.8	94	5.09	....	0.72	4.90	....	0.69	4.73	....	0.67	4.33	....	0.61	4.02	....	0.57
1	....	2	1	....	7.6	51	3.67	....	1.03	3.48	....	0.98	3.30	....	0.93	2.93	....	0.82	2.65	....	0.75
1	....	3	1	....	11.4	36	....	....	....	2.69	....	1.14	2.54	....	1.07	2.22	....	0.94	1.98	....	0.84
1	....	4	1	....	15.2	29	....	....	....	....	....	....	....	....	....	1.78	....	1.00	1.58	....	0.89
1	....	5	1	....	19.0	25	....	....	....	....	....	....	....	....	....	1.49	....	1.05	1.31	....	0.92
1	....	6	1	....	22.8	22	....	....	....	....	....	....	....	....	....	1.28	....	1.08	1.12	....	0.95
1	....	7	1	....	26.6	20	....	....	....	....	....	....	....	....	....	....	....	....	0.98	....	0.97
1	....	8	1	....	30.4	19	....	....	....	....	....	....	....	....	....	....	....	....	0.87	....	0.98
1	....	9	1	....	34.2	18	....	....	....	....	....	....	....	....	....	....	....	....	0.78	....	0.99
1	....	10	1	....	38.0	17	....	....	....	....	....	....	....	....	....	....	....	....	0.71	....	1.00
1	....	11	1	....	41.8	16	....	....	....	....	....	....	....	....	....	....	....	....	0.65	....	1.01
1	....	12	1	....	45.5	15	....	....	....	....	....	....	....	....	....	....	....	....	0.60	....	1.01
1	1	1½	1	3.8	5.7	99	3.19	0.45	0.67	3.08	0.43	0.65	2.97	0.42	0.63	2.78	0.39	0.59	2.62	0.37	0.55
1	1	2	1	3.8	7.6	75	2.85	0.40	0.80	2.73	0.38	0.77	2.62	0.37	0.74	2.43	0.34	0.68	2.26	0.32	0.64
1	1	2½	1	3.8	9.5	61	2.57	0.36	0.90	2.45	0.34	0.86	2.34	0.33	0.82	2.15	0.30	0.76	1.99	0.28	0.70
1	1	3	1	3.8	11.4	51	2.34	0.33	0.99	2.22	0.31	0.94	2.12	0.30	0.90	1.93	0.27	0.82	1.77	0.25	0.75
1	1½	2	1	5.7	7.6	93	2.49	0.53	0.70	2.40	0.51	0.68	2.31	0.49	0.65	2.16	0.46	0.61	2.03	0.43	0.57
1	1½	2½	1	5.7	9.5	76	2.27	0.48	0.80	2.18	0.46	0.77	2.09	0.44	0.74	1.94	0.41	0.68	1.80	0.38	0.63
1	1½	3	1	5.7	11.4	64	2.09	0.44	0.88	2.00	0.42	0.84	1.91	0.40	0.81	1.76	0.37	0.74	1.63	0.34	0.69
1	1½	3½	1	5.7	13.3	55	1.94	0.41	0.96	1.84	0.39	0.91	1.76	0.37	0.87	1.61	0.34	0.79	1.48	0.31	0.73
1	1½	4	1	5.7	15.2	49	1.80	0.38	1.01	1.71	0.36	0.96	1.63	0.34	0.92	1.48	0.31	0.83	1.36	0.29	0.77
1	1½	4½	1	5.7	17.1	44	1.69	0.36	1.07	1.60	0.34	1.01	1.51	0.32	0.96	1.37	0.29	0.87	1.25	0.26	0.79
1	1½	5	1	5.7	19.0	40	1.59	0.34	1.12	1.50	0.32	1.06	1.42	0.30	1.00	1.28	0.27	0.90	1.17	0.25	0.82
1	2	3	1	7.6	11.4	75	1.89	0.53	0.80	1.81	0.51	0.76	1.74	0.49	0.74	1.61	0.45	0.68	1.50	0.42	0.63
1	2	3½	1	7.6	13.3	65	1.76	0.49	0.87	1.68	0.47	0.83	1.61	0.45	0.79	1.48	0.42	0.73	1.38	0.39	0.68
1	2	4	1	7.6	15.2	57	1.65	0.46	0.93	1.57	0.44	0.88	1.50	0.42	0.84	1.38	0.39	0.78	1.27	0.36	0.72
1	2	4½	1	7.6	17.1	51	1.55	0.44	0.98	1.48	0.42	0.94	1.41	0.40	0.89	1.28	0.36	0.81	1.18	0.33	0.75
1	2	5	1	7.6	19.0	47	1.47	0.41	1.03	1.39	0.39	0.98	1.32	0.37	0.93	1.20	0.34	0.84	1.10	0.31	0.77
1	2	5½	1	7.6	20.9	43	1.39	0.39	1.08	1.31	0.37	1.01	1.25	0.35	0.97	1.13	0.32	0.87	1.03	0.29	0.80
1	2	6	1	7.6	22.8	40	1.32	0.37	1.11	1.25	0.35	1.06	1.18	0.33	1.00	1.06	0.30	0.89	0.97	0.27	0.82
1	2½	3	1	9.5	11.4	87	1.72	0.61	0.73	1.66	0.58	0.70	1.60	0.56	0.68	1.49	0.52	0.63	1.40	0.49	0.59
1	2½	3½	1	9.5	13.3	75	1.62	0.57	0.80	1.55	0.55	0.76	1.49	0.52	0.73	1.38	0.49	0.68	1.29	0.45	0.64
1	2½	4	1	9.5	15.2	66	1.52	0.54	0.86	1.46	0.51	0.82	1.40	0.49	0.79	1.29	0.45	0.73	1.19	0.42	0.67
1	2½	4½	1	9.5	17.1	60	1.44	0.51	0.91	1.37	0.48	0.87	1.31	0.46	0.83	1.20	0.42	0.76	1.11	0.39	0.70
1	2½	5	1	9.5	19.0	54	1.37	0.48	0.96	1.30	0.46	0.92	1.24	0.44	0.87	1.13	0.40	0.80	1.04	0.37	0.73
1	2½	5½	1	9.5	20.9	49	1.30	0.46	1.01	1.23	0.43	0.95	1.17	0.41	0.91	1.07	0.38	0.83	0.98	0.34	0.76
1	2½	6	1	9.5	22.8	46	1.24	0.44	1.05	1.17	0.41	0.99	1.11	0.39	0.94	1.01	0.36	0.85	0.92	0.32	0.78
1	2½	6½	1	9.5	24.7	42	1.18	0.42	1.08	1.12	0.39	1.02	1.06	0.37	0.97	0.96	0.34	0.88	0.88	0.31	0.80
1	2½	7	1	9.5	26.6	40	1.13	0.40	1.11	1.07	0.38	1.05	1.01	0.36	0.99	0.91	0.32	0.90	0.83	0.29	0.82
1	3	4	1	11.4	15.2	76	1.42	0.60	0.80	1.36	0.57	0.77	1.30	0.55	0.73	1.21	0.51	0.68	1.12	0.47	0.63
1	3	4½	1	11.4	17.1	68	1.34	0.57	0.85	1.28	0.54	0.81	1.23	0.52	0.78	1.13	0.48	0.72	1.05	0.44	0.66
1	3	5	1	11.4	19.0	61	1.28	0.54	0.90	1.22	0.52	0.86	1.17	0.49	0.82	1.07	0.45	0.75	0.99	0.42	0.70
1	3	5½	1	11.4	20.9	56	1.22	0.52	0.94	1.16	0.49	0.90	1.11	0.47	0.86	1.01	0.43	0.78	0.93	0.39	0.72
1	3	6	1	11.4	22.8	52	1.16	0.49	0.98	1.11	0.47	0.94	1.05	0.44	0.89	0.96	0.41	0.81	0.88	0.37	0.74
1	3	6½	1	11.4	24.7	48	1.12	0.47	1.02	1.06	0.45	0.97	1.01	0.43	0.92	0.92	0.39	0.84	0.84	0.35	0.77
1	3	7	1	11.4	26.6	45	1.07	0.45	1.05	1.01	0.43	0.99	0.96	0.40	0.95	0.87	0.37	0.86	0.80	0.34	0.79
1	3	7½	1	11.4	28.5	42	1.03	0.44	1.09	0.97	0.41	1.02	0.92	0.39	0.97	0.83	0.35	0.88	0.76	0.32	0.80
1	3	8	1	11.4	30.4	40	0.99	0.42	1.11	0.93	0.39	1.05	0.88	0.37	0.99	0.80	0.34	0.90	0.73	0.31	0.82
1	4	5	1	15.2	19.0	76	1.13	0.64	0.80	1.08	0.61	0.76	1.04	0.59	0.73	0.96	0.54	0.68	0.90	0.51	0.63
1	4	6	1	15.2	22.8	64	1.04	0.59	0.88	0.99	0.56	0.84	0.95	0.54	0.80	0.87	0.49	0.73	0.81	0.46	0.68
1	4	7	1	15.2	26.6	55	0.96	0.54	0.95	0.92	0.52	0.91	0.88	0.50	0.87	0.80	0.45	0.79	0.74	0.42	0.73
1	4	8	1	15.2	30.4	49	0.90	0.51	1.01	0.85	0.48	0.96	0.81	0.46	0.91	0.74	0.42	0.83	0.68	0.38	0.77
1	4	9	1	15.2	34.2	44	0.84	0.47	1.06	0.80	0.45	1.01	0.76	0.43	0.96	0.68	0.38	0.86	0.63	0.35	0.80
1	4	10	1	15.2	38.0	40	0.79	0.44	1.11	0.75	0.42	1.06	0.71	0.40	1.00	0.64	0.36	0.90	0.58	0.33	0.82
1	5	10	1	19.0	38.0	47	0.73	0.52	1.03	0.69	0.49	0.97	0.66	0.46	0.93	0.60	0.42	0.84	0.55	0.39	0.77
1	6	12	1	22.8	45.5	46	0.62	0.52	1.04	0.58	0.49	0.98	0.56	0.47	0.94	0.50	0.42	0.84	0.46	0.39	0.78

Note—Variations in the fineness of the sand and the compacting of the concrete may affect the quantities 10 per cent in either direction.

*Use 50 per cent columns for broken stone screened to uniform size. †Use 45 per cent columns for average conditions and for broken stone with dust screened out. ‡Use 40 per cent columns for gravel or mixed stone and gravel. §Use these columns for scientifically graded mixtures.

GF Steel-Tile Floor Construction

Building Materials

The following materials particularly adapted to fireproof construction are manufactured by The General Fireproofing Company:

Self-Sentering
Herringbone Metal Lath
Trussit
Steel-Tile for Floors
Key Expanded Metal Lath
Expanded Metal
Cold Rolled Channels
Corner Bead
Wall Ties

The GF trade-mark is a guarantee of quality in the materials themselves and of intelligent service on all building operations.

Special literature covering each of the above materials will be sent to anyone interested.

GF Waterproofing Materials

In addition to the structural materials named The General Fireproofing Company produces a full line of Waterproofing Materials.

Write our Waterproofing Service Department for information at any time—their advice will be complete and dependable and, if you wish, in the form of specifications for the work.

The Waterproofing Handbook mailed on request.

STEEL-TILE FLOOR CONSTRUCTION